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**Knibbe, Ruth; Ebbesen, Sune Dalgaard; Mogensen, Mogens Bjerg**

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## Origin of polarisation losses in solid oxide electrolysis cells operated at high current density

R. Knibbe, S. D. Ebbesen & M. Mogensen  
 Fuel Cells and Solid State Chemistry Division  
 Risø National Laboratory for Sustainable Energy  
 Technical University of Denmark  
 4000 Roskilde, Denmark

Solid oxide electrolysis cells (SOEC) are being increasingly investigated as a means of producing hydrogen or synthesis gas. The SOEC has the same configuration as a standard solid oxide fuel cell (SOFC), but a current is applied rather than drawn (Figure 1). When SOECs are operated under high current density, the area specific resistance (ASR) increases. However, when the same cells are operated under a SOFC current, the ASR decreases (Figure 1, 2) [1].

For an economic point of view, operation at high current (up to  $\sim 2\text{A}/\text{cm}^2$ ) is interesting to increase the production rate of either hydrogen or synthesis gas [2]. It is therefore of interest to understand the origin of the increased polarisation and degradation behaviour of the cell [3].

Preliminary impedance analysis of fuel electrode supported full cells during electrolysis operation and subsequent modelling suggests that the electrochemical polarisation increase is due to both fuel electrode and the oxygen electrode increases. Under full cell testing, the electrochemical information from the two respective electrodes can be separated by using gas shift impedance. However, the high operating temperatures involved with this work makes it difficult to accurately ascribe processes to the fuel electrode or the oxygen electrode (Figure 1) [4]. Therefore it is of interest to study the effect of the anodic polarisation on (La,Sr)MnO<sub>3</sub>(LSM) – Y<sub>2</sub>O<sub>3</sub>-ZrO<sub>2</sub> Zirconia (YSZ) and cathodic polarisation on Ni-YSZ using 3 electrode pellet studies.

The effect of current density on the cell polarisation and cell degradation will be discussed based on both full Ni/YSZ- YSZ- LSM/YSZ cells and LSM/YSZ electrode response from 3 electrode pellet.

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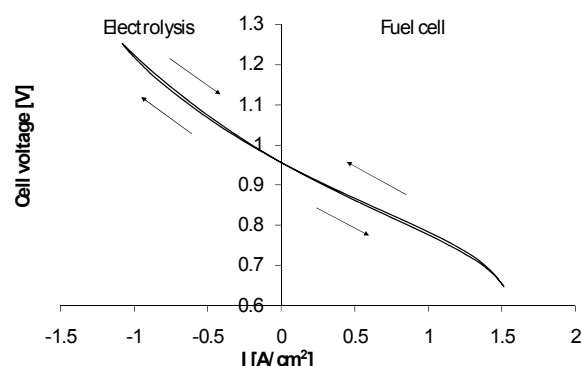


Figure 1: Current-Voltage curve for solid oxide cell operated at 850°C with 50:50 steam:hydrogen gas supplied to the fuel electrode and oxygen supplied to the oxygen electrode.

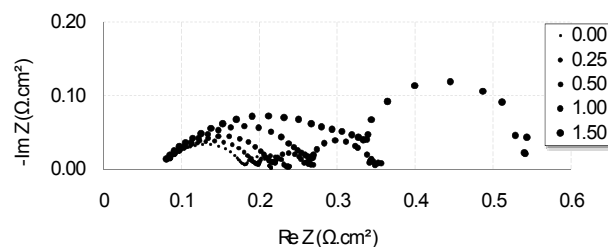


Figure 2: Impedance spectra of SOEC cell operated at 850°C with 50:50 steam:hydrogen gas supplied to the fuel electrode and oxygen supplied to the oxygen electrode under increasing electrolysis current 0, 0.25, 0.50, 1, 1.50 A/cm<sup>2</sup>.